Draft
Sampling and Analysis Plan, Supplemental Bioassay Testing

Harris Avenue Shipyard Site
Bellingham, Washington

Prepared by:

The RETEC Group, Inc.
1011 S.W. Klickitat Way, Suite #207
Seattle, Washington 98134

RETEC Project Number: PORTB-04140-200

Prepared for:

Port of Bellingham
1801 Roeder Avenue
Bellingham, Washington 98225

Exhibit C to draft Agreed Order (Comment period beginning June 10, 2003)

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Prepared by:

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Daniel Berlin, Environmental Scientist

Reviewed by:

_____
Mark Larsen, Senior Project Manager

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List of Acronyms

°C	degrees centigrade
µm	micrometer
ARI	Analytical Resources, Inc.
ASTM	American Society for Testing and Materials
CFR	Code of Federal Regulations
CLP	Contract Laboratory Procedure
cm	centimeter
DGPS	Differential Global Positioning System
DNR	Washington State Department of Natural Resources
DQO	data quality objective
DTS	depth to sediment
Ecology	Washington State Department of Ecology
EDD	electronic data deliverable
EPA	United States Environmental Protection Agency
FTL	Field Team Leader
GIS	Geographic Information System
GPS	global positioning system
MDL	method detection limit
ml	milliliter
MLLW	mean lower low water
MSS	Marine Sampling Services
NAD83	North American Datum 1983
NGVD29	National Geodetic Vertical Datum of 1929
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PM	Project Manager
Port	Port of Bellingham
PPE	personal protective equipment
PSDDA	Puget Sound Dredged Disposal Analysis
PSEP	Puget Sound Estuary Protocols
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	Quality Assurance and Quality Control Plan
QC	quality control
QCM	Quality Control Manager
REG	Rosa Environmental and Geotechnical Laboratory
RETEC	The RETEC Group, Inc.
RI/FS	Remedial Investigation/Feasibility Study
RTK	Real Time Kinematic
SAP	Sampling and Analysis Plan
Shipyard	Harris Avenue Shipyard site
SMS	Sediment Management Standards
SOP	Standard Operating Procedure
SPC	State Plane Coordinates
SVOC	semivolatile organic compound

List of Acronyms

TBT	tributyltin
TOC	total organic carbon
WAC	Washington Administrative Code

1 Introduction

This Sampling and Analysis Plan (SAP) describes procedures for conducting supplemental bioassay sampling for surface sediments at the Harris Avenue Shipyard site (Shipyard) in Bellingham, Washington. This testing is being performed in response to the Washington State Department of Ecology's (Ecology's) comments on a draft investigation and feasibility study Report dated February 15, 2002. The test results will be used to confirm the boundaries within which site remediation will be required.

The field activities will be conducted by The RETEC Group, Inc. (RETEC), on behalf of the Port of Bellingham (Port) and the Washington State Department of Natural Resources (DNR). Field sampling activities are currently scheduled to begin in summer 2003.

A separate sampling plan provides the scope and methods to be used to evaluate the suitability of site sediments for open-water disposal under the Puget Sound Dredged Disposal Analysis (PSDDA) Program. The PSDDA evaluation will be reviewed by all appropriate PSDDA agencies, and copies of the PSDDA plan will be forwarded to those agencies for review and approval. The work described in that plan will be performed after the bioassay results are available. An RI/FS (Remedial Investigation and Feasibility Study) will then be drafted to incorporate the results of both sets of investigations. The RI/FS will be submitted to Ecology for review in compliance with the specifications set forth in the June 10, 2003 draft agreed order.

This document includes the elements of a sediment SAP and a quality assurance and quality control plan (QAPP) consistent with Sediment Management Standards (SMS) requirements contained in Washington Administrative Code (WAC) Chapter 173-204 (Ecology, 1995).

1.1 Sampling Areas

This SAP describes proposed investigation activities to be conducted near the Shipyard in Bellingham Bay. Earlier investigations have identified some contaminated sediments located at the Shipyard (Figure 1-1). Ecology has determined that additional bioassay testing should be performed on sediment at four locations along the northern and western boundaries of the site. These locations may be seen on Figure 1-2. Results of these bioassay tests will determine whether sediment in these areas must be considered for remedial actions, and if so, which of these areas must be further tested to determine feasibility of PSDDA open-water disposal.

1.2 Sampling Overview

Sediment sampling will be conducted at four locations identified by Ecology. Samples will be analyzed for the standard list of Chemicals of Concern as

defined by the SMS (Ecology, 1995) and for bulk tributyltin (TBT). Porewater testing for TBT will be performed if elevated levels of bulk TBT are detected. A list of these chemicals is presented in Section 2. Bioassay testing will consist of a 10-day marine amphipod mortality test with *Ampelisca abdita*, a 20-day juvenile infaunal growth test with *Neanthes arenaceodentata*, and a sediment larval test with *Mytilus (edulis) galloprovincialis*. These tests are further discussed in Section 2.

Locations of bioassay collection stations are shown on Figure 1-2. One reference sample will be collected from nearby Samish Bay with similar grain size and general sediment characteristics.

Sample collection and analytical methods will follow the Puget Sound Estuary Protocols (PSEP) (PSEP, 1986, 1995, 1996a, 1996b, 1996c, 1996d). Field and laboratory activities will be conducted in accordance with the quality assurance/quality control (QA/QC) requirements described in Section 4. Field methods and procedures specified in this plan supersede those described in the RETEC Standard Operating Procedures (SOPs) provided in the appendices, where discrepancies may exist.

2 Sediment Sampling Methods

This section outlines the activities, procedures, and objectives for surface sediment sampling at the site. Field activities will be conducted in accordance with the SAP. Surface sediment will be collected from each of the proposed locations provided on Figure 1-2. Table 2-1 lists the proposed station coordinates (in both state plane coordinates and latitude/longitude). Table 2-2 lists samples to be collected at each station and the associated chemical, biological, and physical analyses. These activities are discussed below.

Specific sampling equipment and methodology may change based on sediment characteristics and site conditions. Modifications and/or deviations from the approved SAP will be documented in the summary report and the subsequent RI/FS. Sampling and analysis will follow PSEP (PSEP, 1986, 1995, 1996a, 1996b, 1996c, 1996d).

2.1 Navigation, Positioning, and Location Control

Positioning and navigation for sediment sample locations will be accomplished using a Real Time Kinematic (RTK) Differential Global Positioning System (DGPS) that allows sub-meter horizontal and vertical accuracy. For this project, a Trimble 4000 global positioning system (GPS) or similar device will be employed. The objectives for the sample station positioning require an accuracy of plus or minus 3 meters. To meet these requirements, the instrument calibration and quality control procedures described below will be followed.

The positioning system will be calibrated over a known location prior to the initiation of any field activities. Datum for all survey data will be reported under North American Datum 1983 (NAD83), Washington State Plane Coordinates (SPC), North 4601. National Geodetic Vertical Datum of 1929 (NGVD29) will be used as the vertical datum for survey data. Data deliverables will include latitude/longitude, northing/easting, and elevation, where applicable. Ecology's SEDQUAL database is maintained in SPC in feet NAD27 North Zone and Geographic Information System (GIS) maps use latitude/longitude decimal degrees projected into NAD27 North Zone. Locations will likely be displayed in these formats. A previously established, land-surveyed DGPS benchmark located near the sampling area will be used prior to initiating field sampling and daily to check the system accuracy.

All samples will be collected within 20 feet of the proposed sample coordinates. If an adequate sample cannot be collected within this radius, the Field Team Leader (FTL) may choose to move 50 feet from the proposed sample coordinates without notifying the Project Manager (PM). The new location must be moved laterally and remain equidistant from the current

cleanup boundary. No sample will be collected outside of a 50-foot radius from the proposed sample coordinates without prior consent from the PM.

Vertical elevation will be determined for all sample locations and will be reported as depth to sediment ([DTS] mudline). When applicable, the DTS will be measured before and after each sampling event. Measurements will be taken by weighted tape and echo sounder. The incremented tape will be pulled taut from the bottom and measured to the nearest tenth of foot. These measurements will then be confirmed with an electronic echo sounder onboard the vessel. The echo sounder method determines depth by bouncing sound waves off the mud layer and back to a receiver. These readings will be correlated to mudline elevations in mean lower low water (MLLW) datum to the nearest 0.1 foot using tide measurements obtained for Bellingham Bay for each of the sampling dates and times.

2.2 Surface Sediment Sampling

Surface sediment samples will be collected using a 0.1 square-meter stainless steel hydraulic van Veen sampler, operated by Marine Sampling Services (MSS). Surface sediment samples will be collected according to the procedures outlined in RETEC SOP 260 (Appendix A).

The surface sediment samples (0 to 12 centimeters [cm]) will be collected for the chemical, physical, and biological testing listed in Table 2-2. This table contains a list of analyte groups, along with analysis methods, holding times, preservatives, and container requirements. Table 2-3 provides a complete list of analytes measured as part of chemical analysis. Specific details on the sediment sampling procedures are described below. Visual classification of sediment samples will be according to the American Society for Testing and Materials (ASTM) standards listed in Table 2-4.

2.2.1 Surface Sample Collection

The *R/V Nancy Anne*, owned and operated by MSS, equipped with a modified hydraulic van Veen sampling device, will be used to collect surface sediment samples. Sampling locations will be approached at slow boat speeds with minimal wake to minimize disturbance of bottom sediments prior to sampling. Sediment samples will be handled carefully to minimize disturbance during collection and transportation to the laboratory.

The grab sampler will be lowered over the side of the boat from a cable wire at an approximate speed of 0.3 feet per second. When the sampler reaches the mudline, the cable will be drawn taut and DGPS measurements recorded. Each surface grab sample will be retrieved aboard the vessel and evaluated for the following acceptance criteria:

- Overlying water is present and has low turbidity;
- Adequate penetration depth is achieved;
- Sampler is not overfilled;
- Sediment surface is undisturbed; and
- No signs of winnowing or leaking from sampling device.

Grab samples not meeting these criteria will be rejected near the location of sample collection and steps repeated until criteria have been met. Deployments will be repeated within a 20-foot radius of the proposed sample location. If adequate penetration is not achieved after multiple attempts, less volume will be accepted and noted in the field notebook. Once accepted, overlying water will be siphoned off and a decontaminated stainless steel trowel, spoon, or equivalent, will be used to collect only the upper 12 cm of sediment from inside of the sampler without touching the sidewalls. The sampler will be decontaminated between stations and rinsed with site water between grabs.

After sample collection, the following information will be recorded on the Field Log Sheet, Sediment Sampling Form, and/or the field notebook (Appendix B).

- Date, time, and name of person logging sample;
- Weather conditions;
- Sample location number and coordinates;
- Project designation;
- Depth of water at the location and surface elevation;
- Sediment penetration and depth;
- Sediment sample interval;
- Sample recovery; and
- Physical observations such as apparent grain size, color, odor, density, layering, anoxic contact, and presence of sheen, shells and/or debris.

2.2.2 Sample Processing

Sulfide samples will be collected from discrete grabs prior to compositing to minimize potential loss of volatiles. Each sulfide sample jar must be completely filled with sediments followed by 2 milliliters (ml) of ZnAc added

on top. In addition, the sample jar must be sealed with a Teflon-lined cap to ensure proper preservation of the sample.

Homogenized sediment will be spooned immediately into appropriate pre-cleaned, pre-labeled sample containers, placed in coolers filled with ice or equivalent, and maintained at 4 degrees centigrade (°C). Materials over 0.5-inch-diameter and debris will be omitted from the sample containers. Surface sediment samples will be submitted for chemical analysis and bioassay testing.

In addition to the location information collected in the field, sample logging of bulk samples will involve physical characterization in general accordance with the visual-manual description procedure (Method ASTM D-2488 modified), details of which are provided in Table 2-4. Physical characterization includes the following:

- Grain size distribution;
- Density/consistency;
- Plasticity;
- Color and moisture content;
- Biological structures (e.g., shells, tubes, macrophytes, bioturbation);
- Presence of debris (e.g., woodchips or fibers, paint chips, concrete, sand blast grit, metal debris);
- Presence of oily sheen; and
- Odor (e.g., hydrogen sulfide).

This information will be recorded on the Sediment Sampling Forms (Appendix B).

Surface sediment samples collected for chemical and physical analysis will be packed and shipped to Analytical Resources, Inc. (ARI) in Tukwila, Washington, in accordance with RETEC SOP 110 (Appendix A). The surface sediment samples for bioassay analysis will be shipped under the same protocol to AMEC, as appropriate.

2.2.3 Grain Size Rapid Wet Sieving

This process separates the sediment sample into size fractions greater than 62.5 micrometers (μm) (i.e., sand and gravel) and less than 62.5 μm (i.e., silt

and clay) for rapid classification of sand and silt/clay fractions. This process helps determine appropriate reference stations with similar grain size fractions (by volume) during field operations. This procedure requires a 62.5-µm sieve, a funnel with diameter slightly greater than that of the sieve frame, a 100-ml graduated cylinder, a squirt bottle, a supply of distilled water, and a bowl for collecting rinse water.

- Place a 62.5-µm (4-phi or 0.0025-inch mesh or #230 mesh size) sieve in a funnel, with a bowl underneath. Moisten the sieve using a light spray of distilled water.

- Place exactly 50 ml of sample in the 100-ml graduated cylinder, add 20 to 30 ml of distilled water, and stir to fluidize the sample.

- Pour the sample into the sieve and thoroughly rinse any residue from the 100-ml graduated cylinder and stir into the sieve.

- Wash the sediment on to the sieve with distilled water using a water pique or squirt bottle having low water pressure. Aggregates can be gently broken using a rubber policeman.

- Continue wet sieving until only clear water passes through the sieve. Take care to ensure that the rinsate does not exceed approximately 950 ml. This is accomplished by sieving an appropriate sample quantity (i.e., a sample volume that is not too large) and by efficient use of rinse water. Both of these techniques may require experimentation before routine wet sieving is started.

- Upon completion of sieving, carefully return the contents (i.e., sand and gravel fraction) of the sieve to the 100-ml graduated cylinder.

- Tap the graduated cylinder gently to settle the solid material.

- Read the volume of solid material from the scale on the side of the graduated cylinder and record the value. The fraction of sample with grain size greater than 62.5 µm is the ratio of the volume of material retained in the sieve to the original volume (50 ml).

2.3 Reference Sample Collection

Toxicity testing requires that appropriate reference sediment be collected and tested with site sediments. Concurrent test on reference sediment are conducted to control for possible sediment grain size effects on bioassay organisms. Bioassays will be run with reference sediment that is well matched to the test sediments for grain size and total organic carbon (TOC). One reference station sample will be collected for bioassay analysis.

Reference stations for bioassay testing are collected to analyze the response of the tests to sediments that are known to be unimpacted from chemical contamination. In addition, it is favorable to collect reference samples that have similar grain size distribution and TOC content as the sediment samples taken from the study area to assure that the reference stations are representative of the sediments in the study area. One reference station sample will be collected from Samish Bay, just south of Bellingham, in order to determine the response of bioassay test organisms to sediments of physical characteristics similar to those of the test sediments. Chemical testing will also be evaluated in the reference sediment to confirm test organism response is not due to chemical contamination.

2.4 Chemistry Analysis Methods

Sediment samples will be analyzed according to the following methods, listed in Table 2-2:

- **SVOCs:** SVOCs by United States Environmental Protection Agency (EPA) Method 8270;
- **PCBs:** EPA Method 8081;
- **Butyl Tin:** Bulk and porewater butyl tin species by PSEP methods;
- **Metals:** Various metals by EPA Methods 6010/7471;
- **Conventional Parameters:** Total solids, total volatile solids, TOC, total sulfides, and ammonia by PSEP methods;
- **Bioassays:** Infaunal *Neanthes arenaceodentata* 20-day infaunal growth test, *Ampelisca abdita* 10-day acute mortality test, and sediment larval test with *Mytilus (edulis) galloprovincialis* or *Crassostrea gigas*; and
- **Grain Size:** By PSEP methods.

2.5 Bioassay Testing Methods

Marine bioassay testing species selection depends on grain size, salinity, and season in which testing will be performed. Based on the currently proposed project schedule, the following bioassay tests will likely be performed:

- *Neanthes arenaceodentata* (Los Angeles karyotype);
- *Ameplisca abdita*; and
- *Mytilus (edulis) galloprovincialis* or *Crassotrea gigas*.

Bioassay testing will be performed according to PSEP guidelines (PSEP, 1995) by AMEC bioassay laboratory in Fife, Washington. AMEC in Fife, Washington is accredited by Ecology to perform each of the above testing procedures according to PSEP guidelines. If species substitutions are required due to the acceptability, availability, or other factors, such substitutions will be confirmed with Ecology prior to test initiation.

2.5.1 Species Selection

Many of the sediment samples located near the proposed collection locations collected as part of the Phase 2 investigation and as part of the RI/FS contain large proportions of fines. For example, samples HG-34 and HG-35 collected during the RI/FS had 76 and 75 percent fines, respectively (ThermoRetec, 2002). Sample HG-13 collected during the Phase 2 sampling had 77 percent fines (ThermoRetec, 1998). Further, HG-34 and HG-35 contained 36 and 35 percent clay, respectively, and HG-13 contained 32 percent clay.

Rhepoxynius abronius is not ideal since it has shown sensitivity to high percent fines in sediments, particularly high clay content sediments, and has exhibited mortalities greater than 20 percent in clean, reference area sediments (DeWitt et al., 1988; Fox, 1993). *Eohaustorius estuaries* also has exhibited sensitivity to high clay content (greater than 30 percent) despite being relatively insenstitive to salinity changes and other effects of grain size. Therefore, *Ampelisca abdita* will be used for the 10-day amphipod test because of its relative insensitivity to grain size up to concentrations of fines greater than 60 percent (USACE, 2000).

For the sediment larval test, adults must be collected in spawning condition or must be induced to spawn in the laboratory. Therefore, seasonality plays a role in selecting a test organism. The preferred species for larval testing is the blue mussel *Mytilus (edulis) galloprovincialis*. According to the Users Manual for the PSDDA Program, *Mytilus (edulis) galloprovincialis* is suitable for test sediments containing at least 60 percent fines, and they spawn naturally in Puget Sound between March and July (USACE, 2000). AMEC bioassay laboratory has had success inducing spawning in *Mytilus (edulis) galloprovincialis* organisms attained from a private supplier. However, if spawning is unable to be induced, another species deemed acceptable for fine-grained sediments (greater than 60 percent fines) that naturally spawns in south Puget Sound from March to June is the Pacific oyster *Crassostrea gigas* (USACE, 2000). AMEC has also had success inducing spawning with supplier provided organisms of this species.

2.5.2 Testing Requirements

The sediment bioassay tests described above will incorporate standard QA/QC procedures to ensure valid test results, including a negative control, positive

control, and reference sediment samples, as well as measurement of overlying water quality during testing.

At a minimum, daily monitoring of pH, dissolved oxygen, temperature, and salinity will be conducted in overlying water. Ammonia in interstitial and overlying water will be measured at test initiation, and also in overlying water at termination.

A negative control for a sediment toxicity test is considered a clean control that consists of a clean, inert material, such as clean sand, and the same freshwater used in the toxicity test. A positive control is considered a toxic control in which a reference toxicant, in this case copper chloride, is used to establish the relative sensitivity of the test organisms. In addition to these laboratory quality control (QC) tests, bioassay tests will be run on reference sediment samples collected in the field from areas free from chemical contamination and with comparable grain size in order to separate toxic effects from unrelated effects (such as grain size). During the test, water quality (e.g., pH, dissolved oxygen, temperature) will be measured to ensure that undue stress in not exerted on the organisms unrelated to the test sediments. Test quality control checklists will be used to ensure that all test elements are followed.

3 Decontamination Procedures

Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross contamination between samples and helps to maintain a clean working environment. The purpose of decontamination is to remove contaminated materials clinging to gloves, boots, equipment, and sample containers prior to their removal from the work area. Decontamination also includes the removal and disposal of contaminated clothing and gloves.

Decontamination is achieved mainly by rinsing with soap or detergent solutions, tap water, deionized water, methanol, dilute acids, or acetone. Equipment will be allowed to air dry after being cleaned. Decontamination will be accomplished between each sample collection station and/or depth.

The following is a list of supplies needed provide decontamination of equipment and personnel:

- Clean gloves – inner and outer;
- Cleaning liquids and dispensers: soap and/or a powdered detergent solution such as Alconox™, tap water, deionized water, and technical grade hexane;
- Waste storage containers: drums, boxes, and plastic bags;
- Plastic ground cover;
- Chemical-free paper towels;
- Cleaning containers: plastic or galvanized steel pans and buckets; and
- Cleaning brushes.

3.1 Sampling Equipment

At a minimum, sampling equipment will be decontaminated prior to initial use and between sampling stations. Sampling equipment (i.e., spoons, bowls) decontaminated prior to field use will be wrapped in aluminum foil and stored in a sealed plastic bag to prevent contamination. Monitoring equipment (i.e., pH probe, tape measures) will be rinsed with distilled water and wiped dry with paper towels. Decontamination methods are detailed in RETEC SOP 120. Decontamination procedures include washing and scrubbing with an Alconox™ soap solution, rinsing with tap water, rinsing with distilled water, and air drying. If heavy, oily substances are found on sampling equipment, Simple Green™ or isopropanol will be used to clean the equipment. Cross

contamination will be minimized by sequencing sampling events from areas of suspected lower concentrations to areas suspected of relatively high concentrations, or from downstream to upstream locations as appropriate.

3.2 Personnel

RETEC has performed prior to sampling at the site. The current investigations will be conducted under Level D protection (disposable Tyvek™ coveralls, steel-toe boots, hardhat, and protective gloves). The following steps will be used for personnel decontamination when using Level D equipment:

1) Wash boots and outer gloves with brush and detergent water, then rinse twice with tap water.

2) Remove disposable Tyvek™ coveralls, then remove outer gloves and place both coveralls and gloves in a disposal container.

3) Wash and remove inner gloves.

4) Wash and rinse face and hands with potable water or waterless cleaner.

5) Shower and shampoo as soon as possible at end of each workday.

All field participants must follow procedures and guidelines contained in the Site-Specific Health and Safety Plan. They must recognize the site health and safety hazards and the protocols required to minimize exposure to such hazards by signing the Acknowledgement Form before beginning work.

3.3 Sediment Sampling Equipment

Equipment used to sample sediment that comes into contact with sediment will be decontaminated before collection of samples. The van Veen sampler will be decontaminated on site following methods outlined in RETEC SOP 120. The deck of the sampling vessel will be hosed down with site water in between sampling stations to minimize cross contamination and tracking of sediment to support zone areas.

4 Project Organization and Responsibilities

The specific roles, activities, and responsibilities of project participants are summarized below. The Port of Bellingham has the primary responsibility for managing the work completed at the site. The primary contact for the Port is Mike Stoner. RETEC is the primary consultant for the Port and is responsible for the activities associated with implementing the supplemental sampling. The daily management of the project will be completed by RETEC staff members including Mark Larsen (PM) and Dan Berlin.

4.1 Project Team

The following additional personnel have been identified for the field investigation.

Field Team Leader

The FTL, Dan Berlin, will support the PM. The FTL is responsible for implementing and coordinating the day-to-day activities of the field team, including health and safety in the field. The FTL will report directly to the PM and will:

- Implement field-related work plans and schedules;
- Coordinate and manage field staff;
- Implement QA/QC for technical data provided by the field staff including field-measurement data;
- Conduct peer reviews of the field performance and reporting products of field crews;
- Write and approve text and graphics required for field-team effort;
- Coordinate and oversee technical efforts of subcontractors assisting the field team;
- Identify problems at the field-team level, resolve issues in consultation with the PM, implement and document corrective action procedures, and communicate with team members and upper management; and
- Participate in preparation of the project deliverables.

The field technical staff will be utilized to mobilize equipment, obtain samples, and gather field data. All designated technical team members will be

experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

Project Manager

The PM, Mark Larsen, is responsible for ensuring completion of project objectives and Quality Assurance (QA) standards. The PM communicates with the Port and DNR and manages schedule, budget, and resources.

Quality Control Manager

The Quality Control Manager (QCM), Keith Faretra, for this project will review and document project performance as it relates to the Work Plan. He will be supported by Anne Fitzpatrick, RETEC's Technical Advisor for the project. As appropriate, the QCM will:

- Assist with laboratory coordination for scheduled analyses;
- Assure that the specified field, analytical, and data management procedures are followed and documented;
- Assess the precision, accuracy, and completeness of the data derived from the investigations;
- Schedule and oversee data validation; issue laboratory audit reports; retain laboratory audit records; and follow up on corrective actions; and
- Finalize electronic data deliverables (EDDs) and import data into the project database.

Health and Safety Officer

The Office Health and Safety Officer will be responsible for the health and safety aspects of this project.

Subcontractors

Local subcontractors will be used as appropriate and when available, without compromising quality, schedule, and cost.

Samples will be collected by RETEC. Chemical analyses of all media will be conducted by ARI, of Tukwila, Washington. Physical analyses (i.e., grain size testing) will be conducted by Rosa Environmental and Geotechnical Laboratory (REG) of Seattle, Washington. AMEC Laboratory of Fife, Washington, will be responsible for biological analysis. Individual laboratory QAPPs and SOPs for each laboratory are on file at RETEC.

MSS of Burley, Washington, under the direction of Bill Jaworski, will be responsible for the sediment collection for the investigation.

4.2 Special Training Requirements/Certification

Specific training requirements for performing fieldwork at the site are as follows:

- All field personnel assigned to the site must have successfully completed 40 hours of training for hazardous site work in accordance with Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120(e)(3) and be current with their 8-hour refresher training in accordance with OSHA 29 CFR 1910.120(e)(8). Documentation of OSHA training is required prior to personnel being permitted to work on site.

- Personnel managing or supervising work on site will also have successfully completed 8 hours of manager/supervisor training meeting the requirements of OSHA 29 CFR 1910.120(e)(4).

- Personnel assigned to the site must be enrolled in a medical surveillance program meeting the requirements of OSHA 29 CFR 1910.120(f). Personnel must have successfully passed an occupational physical during the past 12 months and be medically cleared to work on a hazardous waste site and capable of wearing appropriate personal protective equipment (PPE) and respiratory protection as may be required.

- Personnel assigned to the site who must wear a respirator must be familiar with the OSHA respiratory standard (29 CFR 1910.134). Personnel who are required to wear respirator protection must have successfully passed a respirator fit test within the last 12 months.

It is the responsibility of the employing organization to provide their employees with the required training, medical monitoring, and fit testing prior to assigning them to work at this site. Each employing organization will be responsible for providing documentation of training, monitoring, and fit testing (with make/model of respirator) to the RETEC Project Manager and Field Team Leader prior to sending their employees to the site to work.

All field participants must follow procedures and guidelines contained in the Site-Specific Health and Safety Plan. They must recognize the site health and safety hazards and the protocols required to minimize exposure to such hazards by signing the Acknowledgement Form before beginning work.

5 Quality Assurance/Quality Control Plan

To verify that the data produced during the sediment investigation are of sufficient quality, specific QA/QC requirements will be addressed by field personnel and the analytical laboratory. All laboratory data will be validated, as described below, prior to their use in project reporting.

5.1 Field QA/QC Protocol and Record Keeping

Proper sample collection, identification, preservation, storage and handling procedures, and chain of custody records are necessary for sampling data to be valid and usable. Procedures for these steps are discussed in the previous sections of this sampling plan. The field sampling crew is also responsible for ensuring that the required QA/QC analyses are requested, as indicated in Table 4-1.

5.1.1 Documentation

In addition to sample labels and chain of custody forms, a field logbook will be maintained by the field supervisor to provide a daily record of significant events. All entries will be signed and dated, made in nonerasable ink, and errors will be crossed out and initialed with a single line. The logbook will be kept as a permanent record. All field measurements will be recorded on the appropriate sampling log forms.

5.1.2 Sample Chain of Custody

Samples are considered to be in one's custody if they are: (1) in the custodian's possession or view; (2) in a secured location (under lock) with restricted access; or (3) in a container that is secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s). The principal documents used to identify samples and to document possession are chain of custody (COC) records, field logbooks, and field tracking forms. COC procedures will be used for all samples at all stages in the analytical or transfer process and for all data and data documentation, whether in hard copy or electronic format.

5.1.3 Location Control

DGPS locations and sampling times will be recorded electronically and on the project sampling logs. The DGPS system will be checked using the control point established for the project at least once daily. Any variability of measurements will be recorded in the field logbook. Measurements of water depth will be repeated, with the depth measured to the nearest 0.1 foot. After tidal corrections, mudline elevations will be reported to the nearest 1.0 foot.

5.2 Laboratory QA/QC Requirements

Sediment samples will be stored and analyzed in accordance with the holding time requirements of PSEP (Table 2-2). QA/QC samples will be performed in accordance with PSEP (1996d) and Table 4-1.

At a minimum, the laboratory will comply with the QA/QC requirements shown in Table 4-1. In addition, the analytical laboratory also has separate, instituted internal QA/QC plans. Analyses will be required to conform to accepted standard methods and rigorous internal QA/QC checks prior to final approval and reporting by the laboratory.

The analytical laboratory will provide data reports that will include a cover letter describing any problems or deviations from standard protocols, analytical results, and associated QA/QC materials. The laboratory will retain electronic data necessary to report chromatograms for each sample, mass spectra of detected target compounds, calibration summaries, appropriate sample information (weights, final volumes, and dilutions), and the results of the QC samples.

The final report will include QA2 deliverables, surrogate recoveries where appropriate, and sample chain of custody information (as required by Ecology for SEDQUAL database). Any QA problems (i.e., calibrations, internal standards) must be noted in the laboratory report narrative. Chemical data will be qualified in accordance with PSEP guidelines. The "J" qualifier will be applied to all concentrations that fall between the limit of detection and the laboratory's method detection limit (MDL). Dilution volumes, sample sizes, percent moisture, and surrogate recoveries will be presented on each summary sheet with the analytical results in the data packages. Similar information will also be assembled for each QC sample (method blanks, matrix spikes, etc.).

5.3 Chemical Data Validation

RETEC will review all raw data to verify that the laboratory has supplied the required QA/QC deliverables. The data will then be validated against QA2 level review for acceptable inclusion into the regional SEDQUAL database. All data will be submitted to Ecology's Sediment Management Unit in electronic SEDQUAL format. The review will be performed using EPA CLP guidelines, RETEC SOP 410 (Appendix A), and methods specified in this SAP. QA review of conventional data will be performed using the Data Validation Guidance Manual by PSEP.

The review will evaluate the data for completeness, format, holding conditions, and laboratory QA sample results (e.g., blanks, matrix spikes). The data validation will also include a review of surrogate recovery values for each of the organic samples. Data validation checklists will be prepared.

Where data fail criteria provided in the QA2 manual, the laboratory will be contacted, and the data will be: (1) reanalyzed, (2) qualified, or (3) discarded. Data quality issues will be summarized in a data validation report.

5.4 Bioassay Data Quality Review

A review of the bioassay tests that will be conducted on surface sediment samples collected from Bellingham Bay is necessary to confirm that appropriate and thorough laboratory testing procedures and documentation procedures were followed. Bioassay test data should be compiled and reviewed for validity using the appropriate guidelines and directives set forth in this SAP, and data should be reported according to the established QA/QC procedures. The bioassay laboratory should document and provide an explanation of any exceptions to the established procedures. Overall data usability must be determined if any of the bioassay results are to be used in the decision-making process.

The data quality review will compare bioassay testing holding conditions, test setup, test implementation, and test termination to pertinent bioassay protocols. The review of test setup procedures includes reference sediment collection, organism procurement, number of organisms, number of replicates, volume of sediment, and general test initiation conditions. The review of test implementation includes an evaluation of standard parameters like the length of photoperiod, type of aeration, water replacement, and other daily monitoring variables, including the validity of test termination procedures. It also includes summaries of information pertinent to negative and positive control samples and reference sediment relative to requirements for test success.

The bioassay test validation is based on a RETEC Level II verification protocol. RETEC Level II data verification protocol is followed for preliminary site investigations or ongoing site monitoring events that do not require full documentation and data validation. With Level II data validation, the laboratory is entrusted to follow all internal quality control procedures (i.e., calibrations, performance checks) as directed in the analytical methods reported. A definitive assessment of analytical precision, accuracy, and completeness can be made.

Composited surface samples will be collected for both sediment chemistry analyses and bioassay tests. Samples for bioassay testing will be sent to AMEC for the following bulk sediment toxicity tests:

- *Ampelisca abdita* 10-day mortality;
- *Neanthes arenaceodentata* 20-day growth; and
- *Mytilus (edulis) galloprovincialis* sediment larval test.

Checklists will be used during bioassay test validation to assess the acceptability of the following major test elements:

- Custody, preservation, and holding times;
- Test setup;
- Implementation, including test, control, and reference samples; and
- Reporting.

6 Field Data Management and Reporting

6.1 Field Data Management

Field measurements and observations recorded in field notebooks, on field data forms, or on similar permanent records by field technicians are to become part of the permanent file. Field data is to be recorded directly and legibly in the notebooks or forms with all entries signed and dated.

Managerial documentation consists of:

- Data processing and storage records;
- Sample identification and chain-of-custody records;
- Field changes and variances;
- Document control, inventory, and filing records;
- QA/QC records;
- Health and safety records; and
- Financial and project tracking records.

6.2 Field Data Evaluation

Initial responsibility for verification of accurate entries will lay with the field data logger. At the end of the sampling day, the data logger must sign and date the notebook. Data will then be verified by the FTL or PM, who will review all collected data to ensure that all pertinent information has been entered, and that correct codes and units have been used. The FTL will direct the field data logger to make any necessary corrections to the record and initial them.

After data are reduced into tables or arrays, the task managers will review data sets for anomalous values. Any inconsistencies will be resolved by seeking clarification from the field personnel responsible for data collection.

Managerial and technical data will be verified by the PM for reasonableness and completeness. Random checks of sampling and field conditions will be made by the task managers. The designated QA officer will review selected field data and procedures during random site visits to ensure adherence to the SAP and RETEC SOPs. Whenever possible, peer review will also be incorporated into the data evaluation process in order to maximize consistency among field personnel. All data evaluation will be verified by a dated signature.

The QA officer will monitor and audit performance of the QA procedures to assure that the project is performed in accordance with approved quality assurance procedures. The QA officer or authorized representative will

conduct audits to evaluate the execution of sample identification, field notebooks, and sampling procedures. The field audit program will have preventative maintenance procedures to ensure vital equipment is functioning properly. These procedures include cleaning/decontamination of equipment, daily visual inspection, and routine maintenance of parts depending on the type of equipment used.

6.3 Corrective Actions

The purpose of the evaluation process is to qualify or eliminate field information or samples that were not collected or documented in accordance with specified protocols outlined in the SAP/SOP. The Field Team Leader will review the procedures being implemented in the field for consistency with the established protocols. Sample collection, preservation, labeling, etc., will be checked for completeness. Where procedures are not in compliance with the specified protocols, the deviations will be field documented and reported to the Task Manager. Corrective actions will be defined by the Field Team Leader and Task Manager and documented and implemented as appropriate.

6.4 Field Sampling Quality Control Report and Schedule

At the end of the field investigations, a report will be prepared and submitted to the task manager. This report will include copies of the field notebook, Chain-of-Custody Forms, or any other pertinent field records. Any deviations from the SAP or SOPs that will result in a compromise of the project goals will be flagged and discussed in the report.

7 References

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Tables

Table 2-1 Harris Avenue Shipyard Proposed Supplemental Bioassay Sediment Station Locations

Station	NAD27, Washington State Plane Coordnates, North (feet) [1]		NAD83, Washington State Plane Coordnates, North (feet) [1]		Global Positioning Coordinates [1]	
	Northing (y axis)	Easting (x axis)	Northing (y axis)	Easting (x axis)	Latitude	Longitude
Test Stations						
HB-1	632942.3812	1594574.807	632888.4659	1234693.768	48.72298953	122.5129401
HB-2	632946.5808	1594357.03	632892.6674	1234475.986	48.722988	122.5138424
HB-3	632951.5205	1594119.069	632897.6092	1234238.018	48.72298729	122.5148284
HB-4	632684.5456	1594114.902	632630.632	1234233.849	48.72225546	122.5148215
Reference Station						
REF-1	582112.09	1588588.88	582057.73	1228707.33	48.58316667	122.5343611

Notes:

[1] Proposed coordinates are in Washington State Plane North Zone (feet) North American Datum (NAD) 1927 and converted to Washington State Plane North Zone NAD 1983 and World Geodetic System (WGS), 1984.

Table 2-2 Analyte Categories, Analysis Methods, Holding Times, and Container Requirements

Analyte Category	Analysis Method	Holding Time 4°C	Holding Time -11°C	Jar Requirements
Semivolatile Organics	USEPA 8270	14 days to extraction, 40 days from extraction to analysis	1 year	16-ounce Glass
PCBs	USEPA 8081	14 days to analysis	NA [1]	8-ounce Glass
Butyl tin species - porewater	PSEP	14 days to analysis	NA [1]	1-L Glass
Butyl tin species - bulk	PSEP	14 days to analysis	NA [1]	8-ounce Glass
Metals	USEPA Methods 6010/7471	6 months (28 days for mercury)	NA [1]	4-ounce Glass
Conventionals				
Total Solids	PSEP	7 days	6 months	4-ounce Glass
Total Volatile Solids	PSEP	7 days	6 months	
pH	USEPA 9045	NA	6 months	
Total Organic Carbon	PSEP	28 days	6 months	
Ammonia	PSEP	28 days	6 months	
Total Sulfides	PSEP	7 days dark	NA	4-ounce Glass topped with 2 ml 2N ZnAc headspace free
Physical				
Physical Grain Size	PSEP	6 months	NA [1]	16-ounce Glass
Biological [2]				
Neanthes Arenaceodentata 20-day Growth	PSEP	2 months	NA [1]	(3) - 2-liter Plastic headspace free
Ampelisca abdita 10-day Mortality	PSEP			
Mytilus (edulis) galloprovincialis larvae	PSEP			

Notes:

[1] Holding parameters only specify that the sample must be processed within a period of time that does not allow water loss (per Harold Benny, Rosa Environmental).

[2] Samples will be stored at 4 °C to maximize sample integrity and minimize changes from the presence of biota and/or organic carbon.

Table 2-3 Sediment Chemical Analysis Methods, Target Detection Limits, and Criteria

Parameter	Preparation Method	Analysis Method	Target MDL [1]	SMS Criteria [2] SQS	SMS Criteria [2] MCUL
Conventionals					
Total Solids (%)	--	PSEP [4a]	0.1	nv	nv
Total Volatile Solids(%)	--	PSEP [4a]	0.1	nv	nv
Total Organic Carbon (%)	--	PSEP [4b]	0.1	nv	nv
Ammonia (mg/kg)	--	EPA 350.1 [5]	1	nv	nv
Total Sulfides (mg/kg)	--	PSEP [4a]	10	nv	nv
Grain Size (%)	--	PSEP [4a]	1	nv	nv
Metals (mg/kg)					
Antimony	Appendix D [4]	GFAA [6]	5	nv	nv
Arsenic	Appendix D [4]	GFAA [6]	5	57	93
Cadmium	Appendix D [4]	GFAA [6]	0.2	5.1	6.7
Chromium	Appendix D [4]	ICP [7]	0.5	260	270
Copper	Appendix D [4]	ICP [7]	0.2	390	390
Lead	Appendix D [4]	ICP [7]	2	450	530
Mercury	MER [8]	7471 [8]	0.05	0.41	0.59
Nickel	Appendix D [4]	ICP [7]	0.01	nv	nv
Silver	Appendix D [4]	GFAA [6]	0.3	6.1	6.1
Zinc	Appendix D [4]	ICP [7]	0.6	410	960
Organotins (µg/L in porewater)*					
Monobutyl Tin	Appendix A [3]	PSEP [3]	0.043 [1]	nv	nv
Dibutyl Tin	Appendix A [3]	PSEP [3]	0.143 [1]	nv	nv
Tributyl Tin	Appendix A [3]	PSEP [3]	0.063 [1]	0.05 [13]	nv
Organotins (µg/kg)					
Monobutyl Tin	Appendix A [3]	PSEP [3]	6.72 [1]	nv	nv
Dibutyl Tin	Appendix A [3]	PSEP [3]	5.97 [1]	nv	nv
Tributyl Tin	Appendix A [3]	PSEP [3]	1.19 [1]	nv	nv
LPAH (ppm)					
Naphthalene	3550 [9]	8270 [10]	0.02	99	170
Acenaphthylene	3550 [9]	8270 [10]	0.02	66	66
Acenaphthene	3550 [9]	8270 [10]	0.02	16	57
Fluorene	3550 [9]	8270 [10]	0.02	23	79
Phenanthrene	3550 [9]	8270 [10]	0.02	100	480
Anthracene	3550 [9]	8270 [10]	0.02	220	1200
2-Methylnaphthalene	3550 [9]	8270 [10]	0.02	38	64
Total LPAH				370	780
HPAH (ppm)					
Fluoranthene	3550 [9]	8270 [10]	0.02	160	1200
Pyrene	3550 [9]	8270 [10]	0.02	1000	1400
Benzo(a)anthracene	3550 [9]	8270 [10]	0.02	110	270
Chrysene	3550 [9]	8270 [10]	0.02	110	460
Benzofluoranthenes	3550 [9]	8270 [10]	0.02	230	450
Benzo(a)pyrene	3550 [9]	8270 [10]	0.02	99	210
Indeno(1,2,3-cd)pyrene	3550 [9]	8270 [10]	0.02	34	34
Dibenzo(a,h)anthracene	3550 [9]	8270 [10]	0.02	12	33
Benzo(g,h,i)perylene	3550 [9]	8270 [10]	0.02	31	78
Total HPAH				960	5300
Chlorinated Hydrocarbons (ppm)					
1,3-Dichlorobenzene	P&T [11]	8240 [11]	0.0032	nv	nv
1,4-Dichlorobenzene	P&T [11]	8240 [11]	0.0032	3.1	9
1,2-Dichlorobenzene	P&T [11]	8240 [11]	0.0032	2.3	2.3
1,2,4-Trichlorobenzene	3550 [9]	8270 [10]	0.006	0.81	1.8
Hexachlorobenzene	3550 [9]	8270 [10]	0.012	0.38	2.3
Phthalates (ppm)					
Dimethyl phthalate	3550 [9]	8270 [10]	0.02	53	53
Diethyl phthalate	3550 [9]	8270 [10]	0.02	61	110
Di-n-butyl phthalate	3550 [9]	8270 [10]	0.02	220	1700
Butyl benzyl phthalate	3550 [9]	8270 [10]	0.02	4.9	64
Bis(2-ethylhexyl)phthalate	3550 [9]	8270 [10]	0.02	47	78
Di-n-octyl phthalate	3550 [9]	8270 [10]	0.02	58	4500
Phenols (mg/kg)					
Phenol	3550 [9]	8270 [10]	0.020	0.42	1
2-Methylphenol	3550 [9]	8270 [10]	0.006	0.063	0.063
4-Methylphenol	3550 [9]	8270 [10]	0.020	0.67	0.67
2,4-Dimethylphenol	3550 [9]	8270 [10]	0.006	0.029	0.029
Pentachlorophenol	3550 [9]	8270 [10]	0.061	0.36	0.69
Miscellaneous Extractables (mg/kg)					
Benzyl alcohol	3550 [9]	8270 [10]	0.006	0.057	0.073
Benzoic acid	3550 [9]	8270 [10]	0.10	0.65	0.65
Miscellaneous Extractables* (ppm)					
Dibenzofuran	3550 [9]	8270 [10]	0.020	15	58
Hexachloroethane	3550 [9]	8270 [10]	0.020	nv	nv
Hexachlorobutadiene	3550 [9]	8270 [10]	0.020	3.9	6.2
N-Nitrosodiphenylamine	3550 [9]	8270 [10]	0.012	11	11
PCB Compounds (ppm TOC)					
Total PCBs	3550 [9]	8081 [12]	0.058	12	65

Notes:

* Shown for reference.

1 Method detection limit (MDL) values - from Analytical Resources, Inc. (ARI) laboratory - expressed on a dry weight basis.
Note that some SMS criteria are expressed as the carbon-normalized value (ppm TOC) - see note 2 below - direct comparison to the detection limits cannot be made without a TOC conversion factor.

2 Sediment Management Standards (SMS), includes Sediment Quality Levels (SQL) [low screen] and Maximum Chemical Criteria (MCUL) [high screen]; The following are TOC normalized: LPAH, HPAH, Chlorinated hydrocarbons, phthalates, misc.extractables*, and PCBs

3 Puget Sound Estuary Program (PSEP), Recommended Protocols for Measuring Organic Compounds in Puget Sound, 1996.

4a Puget Sound Estuary Program (PSEP), Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound, 1986.

4b Puget Sound Estuary Program (PSEP), Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound, 1996.

5 Plumb, 1981. EPA/U.S. Army Corps of Engineers procedures for measuring ammonia.

6 Graphite Furnace Atomic Absorption (GFAA) Spectrometry. SW-846. EPA, 1986.

7 Inductively Coupled Plasma (ICP) Emission Spectrometry. SW-846. EPA, 1986.

8 Mercury Digestion and Cold Vapor Atomic Absorption (CVAA) Spectrometry, Method 7471. SW-846. EPA 1986.

9 Sonication Extraction of Sample Solids, Method 3550 (Modified). SW-846. EPA, 1986. Method is modified to add matrix spikes before, rather than after, the dehydration step.

10 GCMS Capillary Column, Method 8270. SW-846. EPA, 1986.

11 Purge and Trap Extraction and GCMS Analysis, Method 8240. EPA, 1986.

12 PCBs as Arochlors by Gas Chromatography and Capillary Column Technique, Method 8081. EPA, 1994.

13 Ecology's 1996 SMARM paper establishes 0.050 ug/L as a conceptual equivalent of an SQS for tributyl tin in porewater.

nv - No value currently established under SMS or PSDDA.

Table 2-4 Key for Physical Description of Sediment Samples

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D-2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency is estimated based on visual observation and is presented parenthetically on the test pit logs.

SAND or GRAVEL	Standard Penetration Resistance (N) in Blows/Foot	Visual Description	SILT or CLAY	Standard Penetration Resistance (N) in Blows/Foot	Approximate Shear Strength in TSF	Visual Description
Density			***Consistency***			
Very loose	0–4	freefall	Very soft	0–2	<0.125	ooze, no shape
Loose	4–10	easy penetration	Soft	2–4	0.125–0.25	saggy shape
Medium dense	10–30		Medium stiff	4–8	0.25–0.5	holds shape
Dense	30–50	low penetration	Stiff	8–15	0.5–1.0	holds shape
Very dense	>50	refusal	Very stiff	15–30	1.0–2.0	low penetration
			Hard	>30	>2.0	refusal

Moisture	
Dry	Little perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum; subcategories include soupy and flocculant for increasing moisture content

Minor Constituents	***Percentage (by weight)***
Not identified in description	0–5
Slightly (clayey, silty, etc.)	5–12
Clayey, silty, sandy, gravelly	12–30
Very (clayey, silty, etc.)	30–50
MAJOR CONSTITUENTS	Majority or >50

Surface Sediment Sample Acceptability Criteria (PSEP)

1. Overlying water is present.
2. Water has low turbidity.
3. Sampler is not overfilled.
4. Surface is flat.
5. Penetration depth is acceptable.

Core Sample Acceptability Criteria

1. Core tube not overfilled.
2. Overlying water is present and surface interval is intact.
3. Estimated compaction is not greater than 25%.
4. Core tube appears intact without obstruction and blocking.

Estimated Percentage of Other Minor Constituents

(i.e., shells, wood, organics, plastic, metal brick, refuse)

	Estimated Percentage (by volume)
Dusting	Trace on Surface
Trace	0–5
Occasional	5–10
Moderate	10–30
Substantial	30–50
Majority	>50

Table 4-1 Method QA/QC Sample Frequencies for Analytical Sampling

QA/QC Sample Type	Sampling and Analysis Frequency
Laboratory QA/QC (to be reported and validated)	
Method Blanks	One per 20
Laboratory Control Samples	One per 20
Laboratory Control Duplicates	One per 20
Laboratory triplicates for TOC/Grain Size	One per 20
Detection Limits	Table 2-3
Holding Times	Table 2-2
Surrogate Compounds	Every field & QA/QC sample
Blind certified reference material	One per 20
Laboratory QA/QC (internal lab requirements)	
Initial Calibration	Following Lab SOP
Continuing Calibration	Following Lab SOP
Internal Standards	Following Lab SOP

Appendix A

Standard Operating Procedures

SOP 110—Packing and Shipping Samples

1 Purpose and Applicability

RETEC SOP 110 describes proper packaging methods and shipment of samples to minimize the potential for sample breakage, leakage, or cross contamination, and provide a clear record of sample custody from collection to analysis. Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health and Safety Plan will take precedence over the procedures described in this document.

The United States Environmental Protection Agency (USEPA) Resource Conservation and Recovery Act (RCRA) regulations (40 CFR Section 261.4[d]) specify that samples of solid waste, water, soil, or air collected for the purpose of testing are exempt from regulation when any of the following conditions apply:

- Samples are being transported to a laboratory for analysis;
- Samples are being transported to the collector from the laboratory after analysis; and
- Samples are being stored: (a) by the collector prior to shipment for analyses, (b) by the analytical laboratory prior to analyses, or (c) by the analytical laboratory after testing but prior to return of sample to the collector or pending the conclusion of a court case.

Samples collected by RETEC are generally qualified for these exemptions. RETEC SOP 110 deals only with these sample types.

2 Responsibilities

The field sampling coordinator is responsible for the enactment and completion of the chain-of-custody, and the packaging and shipping requirements outlined here and in project-specific sampling plans.

3 Supporting Materials

The following materials must be on hand and in sufficient quantity to ensure that proper packing and shipping methods and procedures may be followed:

- Chain-of-custody forms and seals;
- Sample container labels;
- Coolers or similar shipping containers;
- Duct tape or transparent packaging tape;
- Ziploc-type bags;

- Protective wrapping and packaging materials;
- Ice or cold packs;
- Shipping labels for the exterior of the ice chest; and
- Transportation carrier forms (Federal Express, Airborne, etc.).

4 Methods and Procedures

All samples must be packaged so that they do not leak, break, vaporize, or cause cross-contamination of other samples. Waste samples and environmental samples (e.g., groundwater, soil, etc.) should not be placed in the same container. Each individual sample must be properly labeled and identified. A chain-of-custody record must accompany each shipping container. When refrigeration is required for sample preservation, samples must be kept cool during the time between collection and final packaging.

All samples must be clearly identified immediately upon collection. Each sample bottle label will include the following information:

- Client or project name, or unique identifier, if confidential;
- A unique sample description;
- Sample collection date and time;
- Sampler's name or initials;
- Indication of filtering or addition of preservative, if applicable; and
- Analyses to be performed.

After collection, identification, and preservation (if necessary), the samples will be maintained under chain-of-custody procedures as described below.

5 Chain of Custody

A sample is considered to be under custody if it is in one's possession, view, or in a designated secure area. Transfers of sample custody must be documented by chain-of-custody forms (ThermoRetec, 2000). The chain-of-custody record will include, at a minimum, the following information:

- Client or project name, or unique identifier, if confidential;
- Sample collector's name;
- Company's (RETEC) mailing address and telephone number;
- Designated recipient of data (name and telephone number);
- Analytical laboratory's name and city;
- Description of each sample (i.e., unique identifier and matrix);
- Date and time of collection;
- Quantity of each sample or number of containers;
- Type of analysis required; and
- Date and method of shipment.

Additional information may include type of sample containers, shipping identification air bill numbers, etc.

When transferring custody, both the individual(s) relinquishing custody of samples and the individual(s) receiving custody of samples will sign, date, and note the time on the form. If samples are to leave the collector's possession for shipment to the laboratory, the subsequent packaging procedures will be followed.

6 Packing for Shipment

To prepare a cooler for shipment, the sample bottles should be inventoried and logged on the chain-of-custody form. At least one layer of protective material should be placed in the bottom of the container. As each sample bottle is logged on the chain-of-custody form, it should be wrapped with protective material (e.g. bubble wrap, matting, plastic gridding, or similar material) to prevent breakage. Each sample bottle should be placed upright in the shipping container. Each sample bottle cap should be checked during wrapping and tightened if needed. Avoid over tightening, which may cause bottle cap to crack and allow leakage. Additional packaging material such as bubble wrap or Styrofoam pellets should be spread throughout the voids between the sample bottles.

Most samples require refrigeration as a minimum preservative. Reusable cold packs or ice placed in heavy-duty Ziploc-type bags should be distributed under the bottom and over the top of the samples. Two or more cold packs or bags should be used. Additional packing material should then be placed to fill the balance of the cooler or container.

Place the original completed chain-of-custody record in a Ziploc-type plastic bag and place the bag on the top of the contents within the cooler or shipping container. Alternatively, the bag may be taped to the underside of the container lid. Retain a copy of the chain-of-custody record with the field records.

Close the top or lid of the cooler or shipping container and rotate/shake the container to verify that the contents are packed so that they do not move. Add additional packaging if needed and reclose.

Place signed and dated chain-of-custody seal at two different locations (front and back) on the cooler or container lid and overlap with transparent packaging tape. The chain-of-custody seal should be placed on the container in such a way that opening the container will destroy the seal. Packaging tape should encircle each end of the cooler at the hinges.

Sample shipment should be sent via an overnight express service that can guarantee 24-hour delivery. Retain copies of all shipment records as provided by the shipper.

7 Quality Assurance/Quality Control (QA/QC)

Recipient of sample container should advise shipper and/or transporter immediately of any damage to container, breakage of contents, or evidence of tampering.

8 Documentation

The documentation for support of proper packaging and shipment will include RETEC or the laboratory chain-of-custody records and transportation carrier's air bill or delivery invoice. All documentation will be retained in the project files.

9 Reference

ThermoRetec, 2000. *Quality Assurance Project Plan for the Phase II RCRA Facility Investigation, BP Amoco North Properties Area, Casper, Wyoming*. ThermoRetec Consulting Corporation, Golden, Colorado. March 31.

SOP 120—Decontamination

1 Purpose and Applicability

RETEC SOP 120 describes the methods to be used for the decontamination of items that may become contaminated during field operations. Decontamination is performed as a QA measure and as a safety precaution. It prevents cross contamination between samples and also helps maintain a clean working environment. Equipment requiring decontamination may include hand tools, monitoring and testing equipment, personal protective equipment, or heavy equipment (e.g., loaders, backhoes, drill rigs, etc.).

Decontamination is achieved mainly by rinsing with liquids that may include soap and/or detergent solutions, tap water, distilled water, and methanol. Equipment may be allowed to air dry after being cleaned or may be wiped dry with paper towels or chemical-free cloths.

All sampling equipment will be decontaminated prior to use and between each sample collection point. Waste products produced by the decontamination procedures, such as rinse liquids, solids, rags, gloves, will be collected and disposed of properly based on the nature of contamination and site protocols. Any materials and equipment that will be reused must be decontaminated or properly protected before being taken off site.

Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health and Safety Plan will take precedence over the procedures described in this document.

2 Responsibilities

It is the responsibility of the field sampling coordinator to ensure that proper decontamination procedures are followed and that all waste materials produced by decontamination are properly managed. It is the responsibility of any subcontractors (e.g., drilling or sampling contractors) to follow the proper designated decontamination procedures that are stated in their contracts and outlined in the project Health And Safety Plan. It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and to ensure that no contaminants are negligently introduced into the environment.

3 Supporting Materials

The following materials should be on hand in sufficient quantity to ensure that proper decontamination methods and procedures may be followed:

- Cleaning liquids and dispensers (soap and/or detergent solutions, tap water, distilled water, methanol, or isopropyl, etc.);

- Personal safety gear, as defined in the project Health And Safety Plan;
- Paper towels or chemical-free cloths;
- Disposable gloves;
- Waste storage containers (e.g., drums, boxes, plastic bags);
- Drum labels, if necessary;
- Cleaning containers (e.g., plastic and/or galvanized steel pans or buckets);
- Cleaning brushes; and
- Plastic sheeting.

4 Methods and Procedures

The extent of known contamination will determine the degree of decontamination required. When the extent of contamination cannot be readily determined, cleaning should be done according to the assumption that the equipment is highly contaminated.

Standard operating procedures listed below describe the method for full field decontamination. If different technical procedures are required for a specific project, they will be spelled out in the project plans.

Such variations in decontamination may include all or an expanded scope of these decontamination procedures:

- Remove gross contamination from the equipment by brushing and then rinse with tap water from top to bottom;
- Wash with detergent or soap solution (e.g., Alconox and tap water);
- Rinse with tap water from top to bottom;
- Rinse with methanol or isopropyl from top to bottom;
- Rinse with distilled water from top to bottom;
- Repeat entire procedure or any parts of the procedure, as necessary; and

- After decontamination procedure is completed, avoid placing equipment directly on ground surface to avoid recontamination.

Downhole drilling equipment, such as augers, split spoons, Shelby tubes, and sand lines, will be decontaminated with pressurized hot water or steam wash, followed by a fresh water rinse. No additional decontamination procedures will be required if the equipment appears to be visually clean. If contamination is visible after hot water/steam cleaning, then a detergent wash solution with brushes (if necessary) will be used.

5 Quality Assurance/Quality Control

To assess the adequacy of decontamination procedures, rinsate blanks should be collected and analyzed for the same parameters as the field samples. Specific number of blanks will be defined in the project-specific sampling plan. In general, one rinsate blank will be collected per ten samples.

6 Documentation

Field notes describing procedures used to decontaminate equipment/personnel and for collection of the rinsate blanks will be documented by on-site personnel. Field notes will be retained in the project files.

SOP 260—Lake and Stream Sediment Sampling

1 Purpose and Applicability

This SOP 260 describes sampling of sediments from stream and lake bottoms. Lake and stream sediment sampling is performed to define the chemical, physical, and/or biological composition of the sediments. Sediment samples may be obtained directly from shallow, slow moving waters using trowels or shovels or from deep water bodies using dredge/clam shell type samplers. Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health and Safety Plan will take precedence over procedures described in this document.

2 Responsibilities

The project manager is responsible for ensuring that a properly designed sampling program is prepared prior to any sample collection. The field sampling coordinator will have the responsibility to oversee and ensure that all sediment sampling is performed in accordance with the project-specific sampling program and SOP 260. In addition, the field sampling coordinator must ensure that all field workers are fully apprised of SOP 260.

3 Supporting Materials

The following materials must be on hand in sufficient quantity to ensure that proper sampling procedures may be followed.

- Project-specific sampling program;
- Personal protection equipment as specified in the Project Health and Safety Plan;
- Paper towels or chemical-free cloths;
- Coolers and ice;
- Dredges (e.g. Ponar) and rope;
- Shovels and/or trowels;
- Sample bottles, containers, and labels;
- Sampling implements (e.g. spoons, scoops, etc);
- Decontamination equipment and solutions;

- Field data sheets and field book;
- Waders or boat;
- Measuring tape; and
- Boating safety gear (e.g., life jackets).

4 Methods and Procedures

Select sample locations and method(s) in accordance with the project-specific sampling plan. Determine and record the depth of water at each sample location. Collect samples using appropriate sampling equipment and proper health and safety gear.

Refer to SOP 210 for guidance when using a trowel or shovel. Retrieve the sample slowly and carefully through the water column to minimize sample loss. If using a dredge, first secure the rope to the dredge. Open the dredge and lock it into position. Slowly lower the dredge through the water column to the bottom sediments. Close the jaws of the dredge by jerking the dredge rope once or twice. Pull the dredge back up through the water column at a steady, even pace. Repeat if sediment recovery is inadequate. Several attempts may be necessary to obtain sufficient sample volume. If, after several attempts, sample volume is still inadequate, adjust the sampling location. All equipment will be decontaminated after each use following the procedures outlined in SOP 120.

Specific procedures pertaining to the handling and shipment of samples shall be in accordance with SOP 110. A clean pair of gloves and decontaminated sampling tools will be used when handling the samples during collection to prevent cross contamination. A representative sample will be placed in the sampling container using a clean implement such as a scoop, spoon or tongue depressor. Sample containers shall be labeled with the following information:

- Client or project name, or unique identifier, if confidential;
- Unique sample description (i.e., sampling point number and horizontal/vertical location);
- Sample collection date and time;
- Sample collector's name or initials; and
- Analyses to be performed.

These data shall be recorded on the sediment sampling form (Figure 1) and/or field book.

If sampling from a boat, all appropriate boating safety regulations must be understood and followed by the sampling crew.

5 Quality Assurance/Quality Control

QA/QC requirements include, but are not limited to, blind field duplicates, blind rinsate blanks, and blind field blanks. These samples will be collected on a frequency of one QA/QC sample per ten field samples or a minimum of one QA/QC sample per day unless otherwise specified in the project-specific sampling plan.

6 Documentation

Documentation may consist of all or part of the following:

- Sediment sampling forms;
- Field log book;
- Chain-of-custody forms; and
- Shipping receipts.

Field records should contain sufficient detail which provide a clear understanding of and where samples were taken. A description of sediments using the Unified Soil Classification system should be included. All documentation shall be placed in the project files and retained following completion of the project.

SOP 410—Quality Assurance/Quality Control Data Validation

1 Purpose and Applicability

RETEC SOP 410 describes the method to be used for evaluating analytical laboratory data collected during field investigations. This evaluation is performed in order to establish the validity of the data generated. The laboratory analytical data will be evaluated for precision, accuracy, and completeness. Specific project requirements as described in an approved Work Plan, Sampling Plan, Quality Assurance Project Plan, or Health & Safety Plan will take precedence over the procedures described in this document.

2 Responsibilities

The project manager will be responsible for ensuring that procedures set forth in the sampling program documents are followed in the field, and in the analytical laboratory. Where procedures differ, the most stringent project-specific document(s) will apply.

The Project Quality Assurance/Quality Control (QA/QC) Officer will be responsible for validating the analytical data for precision, accuracy, and completeness. The QA/QC Officer will work in conjunction with the project manager and Laboratory Coordinator to produce the final report

3 Supporting Materials

Section 3 is not applicable.

4 Methods and Procedures

This section presents the method and procedure for implementation of the RETEC Quality Assurance/Quality Control process for data evaluation. Analytical data will be reviewed for precision, accuracy, and completeness. The following sections provide a detailed discussion of the steps necessary to meet these criteria. The following criteria are recommended and should be evaluated on a project-specific basis.

A preliminary evaluation of the analytical data will include:

- A review of the Work Plan or Quality Assurance Project Plan (QAPP);
- A review of the laboratory project narrative;

- A review of holding times, detection limits, methods of analysis; and

- A check of data flags, reporting units, and sample matrices.

Any deviations from the requirements of the QAPP will be identified in the data evaluation report and the Project Manager will be notified. Additionally, the laboratory will be contacted, if necessary, and appropriate corrective actions will be implemented.

4.1 Evaluation of Precision

Precision is the measure of variability of individual sample measurements. Precision is determined through the analysis of replicate samples, field blanks, trip blanks, and equipment rinseate blanks. A replicate sample represents two or more separate samples collected at the same location. A replicate sample is are often referred to as a duplicate. Additionally, replicates are often submitted to the laboratory as blind samples. Field blanks consist of deionized water poured into sample bottles in the field. These blanks are used to determine whether airborne contamination is present at the site. Trip blanks are laboratory generated analyte-free water samples for volatiles analysis which travel to and from the site with the sample coolers. These blanks are used to document contamination attributed to bottle preparation and/or shipping and handling procedures. Equipment rinseate blanks consist of reagent water exposed directly to sampling equipment. The equipment rinseate blank is useful in documenting adequate decontamination of sampling equipment.

4.1.1 Duplicates

Duplicates, when collected, will be evaluated at the frequency of ten percent (10%) of samples collected for each matrix. Evaluation of replicates for precision will be done using the Relative Percent Difference (RPD). The RPD is defined as the difference between two duplicate samples divided by the mean and expressed as a percent. The RETEC advisory limit for RPDs is 50% for soil samples and 30% for groundwater. When the RPD exceeds the advisory limit, consideration will be given to the possibility of matrix effect. If however professional judgement indicates a potential laboratory error, the positive results will be "J" flagged.

4.1.2 Field Banks

Collection of a field blank is recommended for one in every 20 samples, or one sample per batch if less than 20 samples are collected. However, on a project-specific basis, analysis of field blanks may not be appropriate.

4.1.3 Trip Blanks and Rinseate Blanks

Preparation of a trip blank is recommended at one blank for each cooler if volatile analysis has been requested. Equipment rinseate blanks should be collected during each day of sampling or at a 10% frequency.

4.2 Evaluation of Accuracy

The accuracy of data is a measure of the system bias. The level of accuracy is determined through examination of a Blank Spike (BS), laboratory Matrix Spike/Spike duplicate analyses (MS/MSD), surrogate recoveries for organic analyses, and method blanks. A blank spike is a laboratory QC sample which is introduced with the sample batch to monitor the performance of the system. The BS is used to document laboratory performance and is also referred to as a Lab Control Sample (LCS), Ongoing Precision Recovery (OPR), or Lab Spike (LS). The MS/MSD is an environmental field sample which is spiked with method or client specific analytes. The MS/MSD indicates how well the lab can reproduce the analytical results on field samples. The MS/MSD can indicate matrix effects. Surrogates are compounds that are structurally similar to the compounds requested for analysis, but are not found in nature (i.e., deuterated compounds). hey are analyzed to demonstrate the percent recovery of the method by the laboratory and are applicable only for organic analysis. Method blanks or reagent blanks are analyte-free blank samples that monitor contamination introduced by the laboratory during sample preparation or analysis.

Blank spikes are recommended for one in every twenty sample analyses. A MS/MSD set is recommended for one in every twenty samples. Surrogates are compounds spiked into every sample submitted to the laboratory for organic analysis and have method specific recovery limits. A method blank will be prepared for one in every 20 samples per matrix. Method blanks are used to check on process contamination, carry over, and purity of reagents used by the laboratory.

When a BS is outside of the control limits, the laboratory should first re-analyze the sample. If it is still outside of the control limits, the laboratory should then reextract all samples in the set. If neither of the above have been done by the laboratory, then all of the data should be qualified with either a "J", indicating that the values are estimates, or an "R" which indicates that the results are unusable. The severity of flagging will be based on the professional judgement of the data reviewer and the ultimate use of the data.

MS/MSD percent recoveries and RPDs are compared to published QC limits. If the MS/MSD recoveries and/or RPDs are outside QC limits, but the BS recovery is acceptable, the samples likely have matrix interference problems. If the precision is acceptable between the MS and the MSD, then the reliability of the data is good. If the recovery in the MS or MSD is less than 10%, the corresponding unspiked sample should be qualified with a "J" for

positive hits, and an "R" for non-detected results. Note that this action is taken on the sample alone, not the entire batch of samples.

When surrogate recoveries are outside QC limits, procedures described below will be followed:

- If one Base/Neutral (B/N) and/or one Acid surrogate is outside of the QC limits, and the surrogate recoveries are all greater than 10%, the positive results should then be estimated as "J", while the non-detected results should be estimated as "UJ".

- If two Base/Neutral (B/N) or two Acid surrogates (or more) are outside of the QC limits, or surrogate recovery is less than 10%, the sample should then be re-analyzed.

- If a volatile surrogate is out of QC limits, the sample should be re-analyzed.

- After the laboratory has re-analyzed the surrogates are they still outside of the QC limits, both results should be reported and the outlying recoveries attributed to matrix interference.

- If the laboratory does not re-analyze or re-extract and re-analyze, then the positive results should be flagged with a "J" and the non-detected results flagged with an "R".

- If the surrogates are outside of the QC limits for any blank, then validity of the data should be considered questionable.

4.3 Evaluation of Completeness

Completeness is a measure of the amount of data actually collected, analyzed, and validated compared to the amount specified in the sampling plan. The overall measure of completeness is the ratio of samples planned to valid analyses received. The data quality objective for the data is to achieve 90-100% accuracy and completeness of data collected, unless otherwise stated in the QAPP.

5 Quality Assurance/Quality Control

RETEC will review all data validation procedures on a yearly basis and update OA/QC procedures annually if necessary.

6 Documentation

During the data review/validation process, problems with analytical procedures, analytical results outside QC limits, or other unusual conditions will be documented. In many cases this information will be contained in the laboratory project narrative accompanying the analytical data. Where

additional explanations from the laboratory are required, the information will be documented by the laboratory and provided to RETEC. The QA/QC Officer will summarize the information for inclusion into the QA/QC summary. Documentation of data review/ validation will vary depending upon the level of review required by the individual project.

7 References

Analyses, EPA (1990)

CLP Organic Data Review, EPA (1992)

EPA Contract Laboratory Program (CLP) Guidelines:
Statement of Work : Organdies 2/88
Statement of Work : Organdies 3/90
Statement of Work : Inorganic 9/91
Statement of Work : Dioxin 8/87

Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyzes, EPA Region I (1988)

Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyzes, EPA Region I (1989)

Modified Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyzes, EPA Region III (1992)

Modified Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyzes, EPA Region III (1993)

RARA Laboratory Audit Inspection Guidance Document, EPA (1988)

Superfund Analytical Methods for Low Level Water Organic

Three Levels of Data Review, EPA (1989)

Test Methods for Evaluating Solid Waste, SW-846, Third Edition (1993)

Appendix B

Field Forms

Surface Sediment Field Log

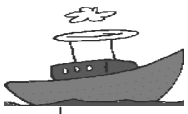
Job: _____ Core Location: _____

Job No: _____ Date: _____ Time: _____

Field Reps: _____ Sample Method: _____

Contractor: _____ Proposed Coordinates: _____

Water Height



DTS Boat: DTS Lead Line:

Mudline Elevation (datum): _____

Tide Measurements

Time/Height: _____

Time/Height: _____

Sample Acceptability Criteria:

1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: _____

Grab #	Time	Confirmed Coordinates (datum)		Sample Accept (Y/N)	Recovery Depth	Comments: (i.e.winnowing, jaws close, biota, overfill, good seal, sample depth)
		Northing	Easting			

Sediment Sample Description: surface cover, (density), moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota)

Composite sample: _____

Sample Containers: _____

Analyses: _____

DAILY FIELD REPORT

Job: Arrival Time:

Location/Client: Departure Time:

Job Number: Weather:

Purpose of Observations:

RETEC Representative: RETEC Project Manager:

Contractor: Permit No.:

Contractor Rep: Job Phone:

ATTENDEES:

SCOPE:

ACTIVITIES:

ACTION ITEMS: